

## **Project's Economic Costs**

### ***Flood Damage Reduction Benefits***

In the project area, the 100-year floodplain of Trout Creek includes the Union Pacific Railroad (UPRR) balloon track, light commercial areas in the eastern portion of the property, and Glenshire Drive. There are costs associated with the flooding of this area which is outside the Trout Creek channel although the costs resulting from past flood events have not been well documented. Therefore, the Economic Cost analysis is primarily qualitative.

### ***Historical Flood Damage***

Over the past 150 years, the lower portion of Trout Creek, a tributary to the Truckee River, has been impacted by development of the downtown, the rail yard, and various other land uses. These impacts have resulted from channelization and realignment of Trout Creek and have upset natural channel processes such as bed load movement, habitat creation, hydrology, and riparian connectivity. Despite past efforts to manage Trout Creek, flooding impacts associated with the 1997 and 2006 rain events occurred. Efforts to manage high flows and address impacts associated with flooding of lower Trout Creek has also resulted in severe impacts to the biological and aesthetic integrity of the stream and riparian system.

Photos of the project area during a 1997 storm event are shown in Attachment 3. Although this flood was estimated to be 60-year or less flood event, it resulted in the inundation of the UPRR balloon track and Glenshire Drive.

### ***Hydraulic Modeling***

To support the Trout Creek Restoration Project, three hydraulic models were developed using HEC-RAS 4.1 river analysis software, developed by the United States Army Corps of Engineers (USACE). The three models were developed to describe existing and proposed conditions. They include:

- Duplicate Effective (FEMA)
- Existing Conditions (Corrected Effective)
- Proposed Conditions (CLOMR)

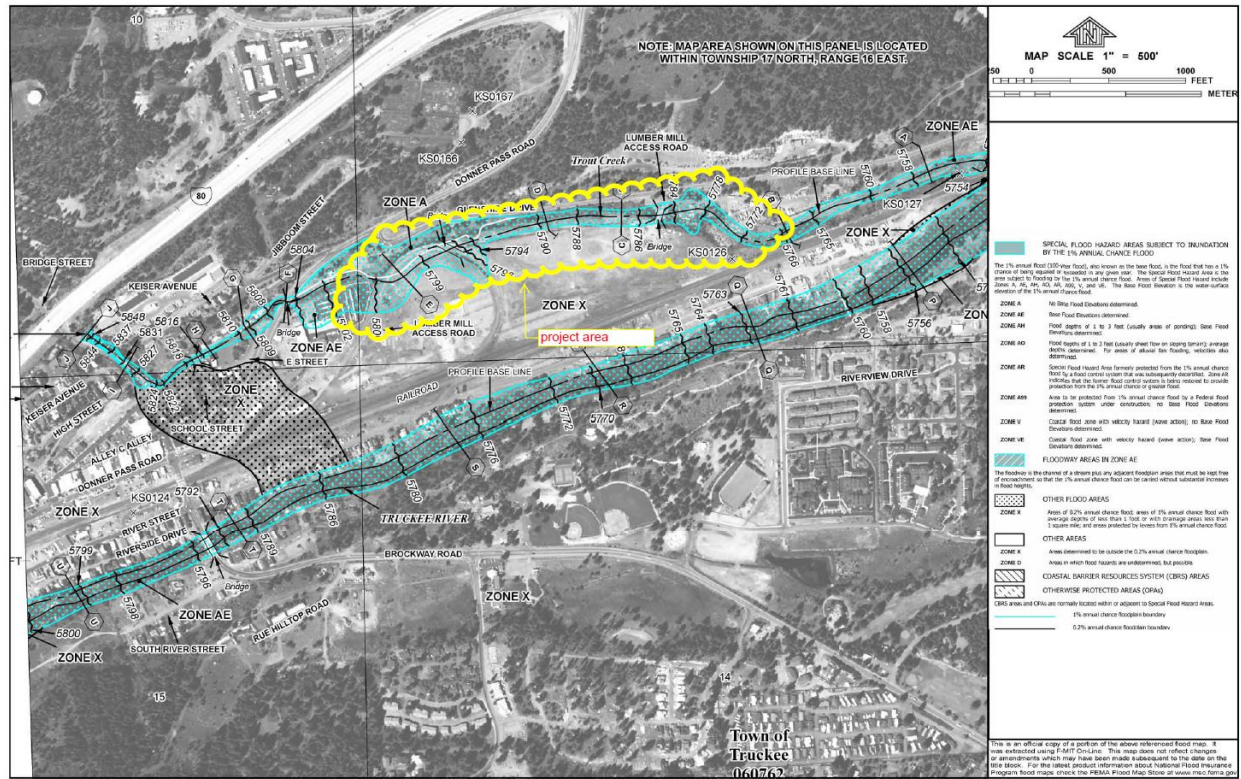
Trout Creek drains a 5.1 square mile, ungaged watershed along the eastern crest of the Sierra Nevada Range. Elevations within the watershed range from 7,300 feet at Donner Ridge to 5,800 feet at the project site. The 100-year peak flow for Trout Creek was estimated by Braithwaite (1996) and PWA (2002) using a variety of methods. Braithwaite calculated a 100 year flood peak for existing and Tahoe-Donner build out conditions using the U.S. Army Corps of Engineers' HEC-1 and HEC-2 models. PWA used a combination of methods, including correlations to the Sagehen Creek gage (#10343500), and regional regression equations developed by the U.S. Geologic Survey (USGS). The various peak flow estimates are presented in Table 1 (below) along with the published FEMA 100-year discharge.

**Table 1: Peak discharge estimates for Trout Creek using a range of methods (from PWA 2002, Braithwaite 1996, FEMA 1997).**

<b>Estimated 100-year discharge for Trout Creek</b>	<b>Q<sub>100</sub> (cfs)</b>
Based on the ratio of drainage areas of Sagehen and Trout Creeks	484
Based on drainage area ratio of Sagehen to Trout Creek, adjusted with coefficient of 0.88 recommended by Waananen and Crippen (1977)	640
By regional regression equations, Waananen and Crippen (1977)	722
N. Braithwaite - Trout Creek Hydrology - Existing conditions	700
N. Braithwaite - Trout Creek Hydrology - Full build-out of Tahoe Donner Resort Community	860
<b>FEMA – (FIS, 1997)</b>	<b>810</b>

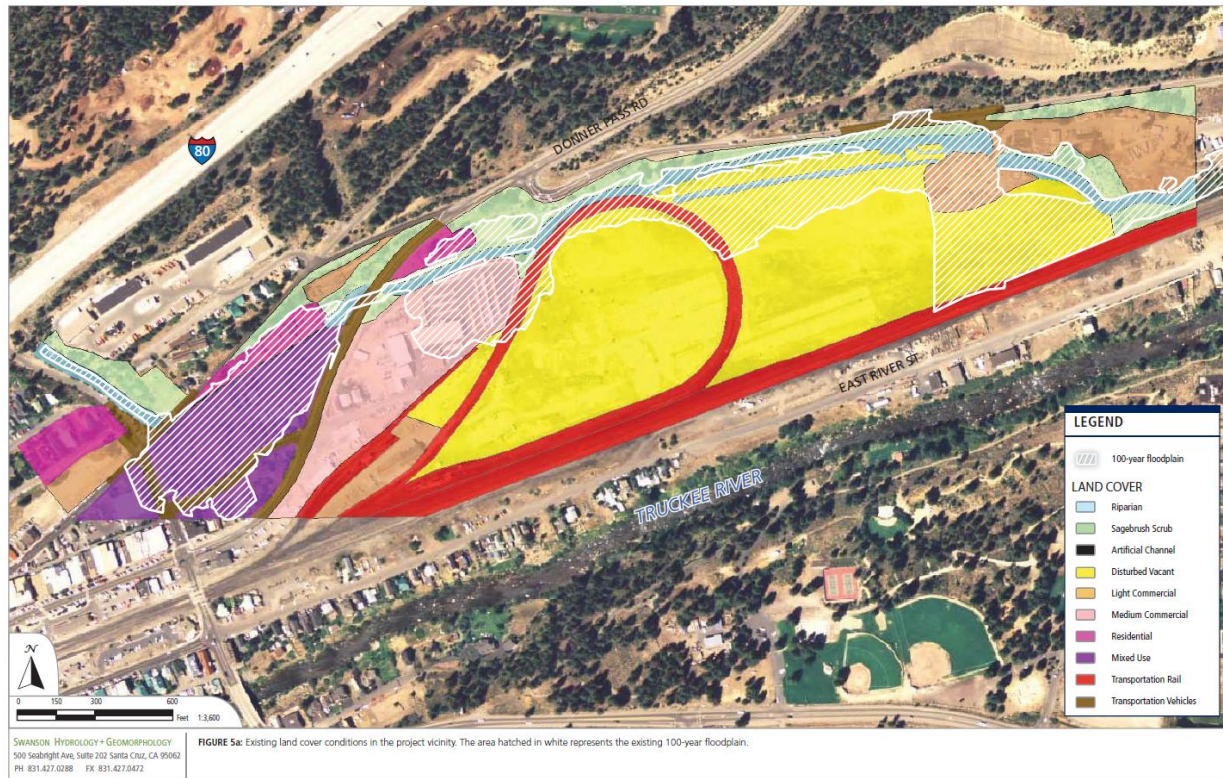
After reviewing the peak flow estimates generated for the site, it was decided that the FEMA 100-year discharge of 810 cfs would be used in the hydraulic models. The FEMA flow was selected because it is the most conservative discharge representing the existing conditions and it allowed for direct comparison between existing FEMA flood mapping data and the hydraulic models developed for the project.

The current FEMA Flood Insurance Rate Map (FIRM) (FEMA, 2010) for Trout Creek has a delineated Zone AE as shown in the Figure below:



To take advantage of higher resolution mapping data for Trout Creek and to evaluate the effects of the proposed restoration design on 100-year water surface elevations, an existing conditions (corrected effective) hydraulic model was prepared for the project area (see figure below). The existing conditions geometry was developed from topographic data. Bridge and culvert dimensions were obtained from field measurements. All elevations are referenced to NGVD 1929.





As shown in the modeled existing floodplain above, the current 100-year floodplain extends into commercial and residential areas, roadways, and parking lots. Within Reaches 4 & 5 of the project study area, the floodplain extends into transportation infrastructure and land used for light commercial. Not only does this pose a public health and safety issue, but it results in property damage.

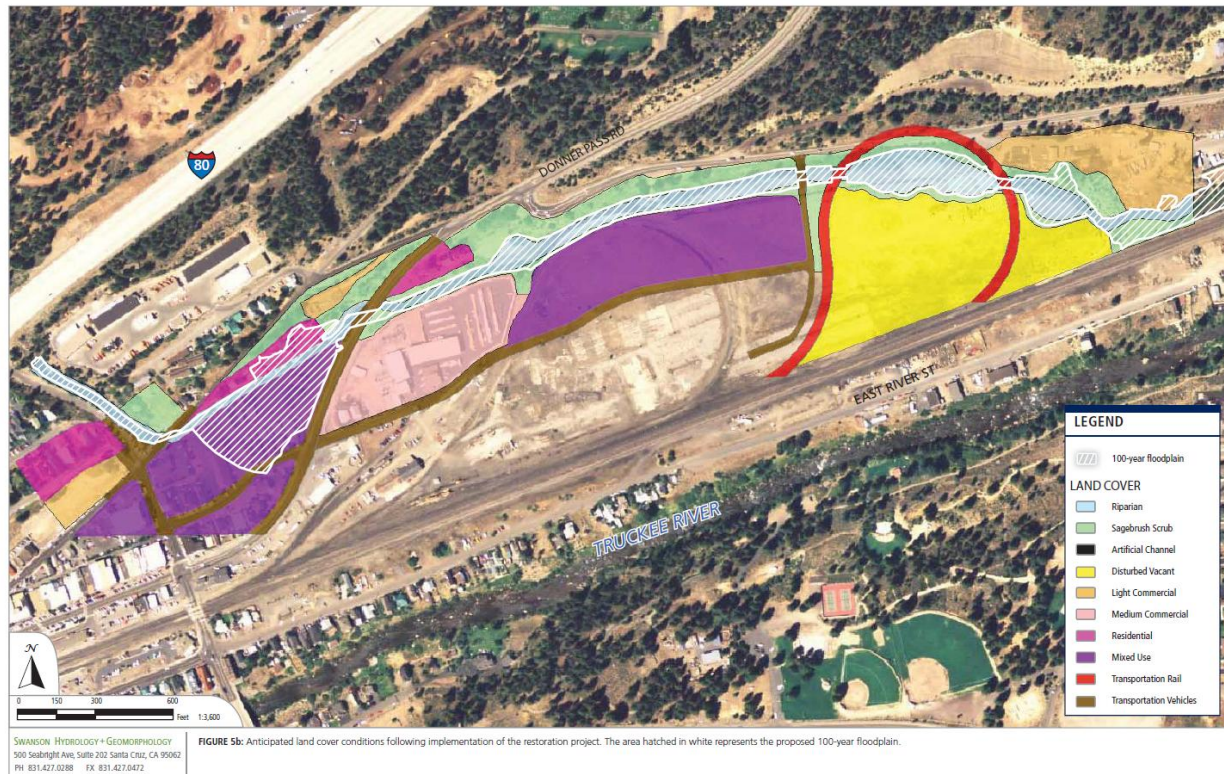
The current flooding potential threatens to damage transportation infrastructure that is not only importance locally, but regionally. First, a portion of Glenshire Drive is in the 100-year floodplain. This road is one of only two routes into or out of the Glenshire Subdivision. With over 1,600 built lots and a population of over 5,000, Glenshire is home to roughly one third of Truckee's residents. Flooding along Glenshire Drive would impact these residents and could interfere with emergency operations. 100-year storm flood waters also cover the UPRR balloon track, which is used to turn trains around. This UPRR route is an important line carrying passengers and freight between California and Chicago. Equipment and materials that are stored in both the UPRR property and the light commercial/industrial area located in the eastern portion of the project area are also put at risk by potential flooding.

The current flooding condition also threatens ecosystems. A significant portion of the 100-year floodplain encompasses vacant disturbed and mostly un-vegetated land on the UPRR property. During flooding events, this land is inundated, causing significant erosion on this land that was previously used for industrial uses. This erosion has the potential to harm the Trout Creek ecosystem. In addition, Trout Creek is a tributary of the Truckee River which is listed as impaired due to sediment and has established Total Maximum Daily Loads (TMDLs). The

reduction of flooding in these previously disturbed and industrial and transportation areas would reduce the potential for sediment to enter Trout Creek and the Truckee River during a storm event. In addition, the Creek restoration project is designed to improve the natural filtration system of the creek, thereby reducing sediment transport to the Truckee River.

### ***Proposed Conditions***

As shown in the figure below, the proposed project, plans for which are included in the Swanson Hydrology 30% Design Report, would confine the 100-year floodplain within the creek channel.



The beneficiaries of this project are:

- Property owners along the project alignment, which will receive substantial improvements in flood protection.
- UPRR and Town of Truckee with improved protection of their infrastructure.
- General public for aesthetic improvements and improvement of ecological function.
- Fish and wildlife in the Trout Creek and Truckee River corridors as the project improves ecological function of the creek.

The flooding protection benefits will occur immediately after construction is complete. However, the ecological benefits may take a few years to realize because the vegetation must be established before habitat is created.



The Town does not foresee any adverse effects generated by the project.

***Anticipated Annual Maintenance Costs***

Because one of the project goals it to restore the natural function of the creek, very little maintenance is expected to be required. There will not be Administrative or Operational costs associated with the creek. However, some maintenance may be required. The maintenance cost was assumed to be \$1,000 a year, which is adequate to fund roughly 30 hours of Public Works staff time a year. No replacement costs are expected in the 50 year period, primarily because the life span of the structures exceeds 50 years.

***Documentation***

Swanson Hydrology 30% Design Report and Plans